

Pitch canker-terminator of economic viability for New Zealand's commercial forest estate?

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Abstract

Pitch canker disease of *Pinus spp.*, caused by the fungus *Fusarium circinatum*, is a serious disease of plantation and amenity pines in the south-eastern United States and California and a problem in forest nurseries in South Africa and Chile. *Pinus radiata* is known to be very susceptible to the disease. This paper attempts to quantify the possible economic impact of its establishment on the radiata pine industry in New Zealand under one potential scenario and comments on other potential scenarios. The cost of eradication attempts is addressed. It seems likely that should *F. circinatum* arrive in New Zealand it would be a serious nursery pest. However, its impact in *P. radiata* plantations is still a matter of some conjecture.

Introduction

Pitch canker, caused by the fungus *Fusarium circinatum*, currently heads the list of undesirable and unwanted overseas pests for the plantation forest industry in New Zealand, and has done so for at least the past 10 years. Although some other pests and diseases, such as bark beetles and western gall rust, are still perceived as threats to the economic viability of the industry they are relatively insignificant compared to pitch canker.

The vulnerability of the radiata pine estate in New Zealand to pitch canker disease remains speculative. The potential for infection of wounds from airborne spores without the intervention of insects carrying the fungus is not yet known. The ability of those insects currently present in New Zealand to vector the fungus is assumed to be low, and the absence of aggressive bark beetles means that the disease could have considerably less effect here than in the United States.

There are a number of variables that influence the way the fungus behaves. These include host species, climate/environmental factors, vector availability (if necessary), and competitors (other organisms inhabiting the niche in various ways). The way the disease manifests in any location is a complex inter-relation of these factors. Researchers in California have however suggested

that one of the most crucial is the presence/absence of suitable insect vectors.

In South Africa where the disease has been present for 10 years, and in Chile where it was reported in 2001, the disease has so far been primarily a disease of nursery seedlings or cuttings. It is only recently that newly established planting stock in South African plantations has been found to develop stem infections. It is thought that the fungus may have been transported with the stock from the nursery.

Evaluating the threat to New Zealand

1. Nurseries

We can predict with reasonable confidence the effect of an introduction of *F. circinatum* to a nursery in New Zealand. The fungus has been reported to be capable of spreading through nurseries very rapidly, with devastating losses recorded. Unlike older trees, wounds are not required for infection of very young seedlings, and insect-vector transmission is not important. Unfortunately, in contrast to the majority of pine nursery diseases where diligent application of fungicides will generally reduce the pathogen to relative impotence, chemical control of pine pitch canker disease has been found to have relatively limited effectiveness. The downstream effect of widespread nursery failure would be significant.

2. Plantations

The impact of an outbreak of pine pitch canker in a plantation will depend on how, where and when it occurs, the nature of the response, the rate of spread, and the extent of the impact on existing tree crops. No figures pertaining to the economic impact on a commercial radiata pine plantation are available (as there are no such plantations in California and no published reports from elsewhere). However some extrapolation from other studies is possible. In south-eastern USA, pine pitch canker is known to reduce volume growth of infected southern pines (*Pinus elliottii* and *P. taeda*) by 20-40% although mortality is low.

Using information from published studies in the US, particularly from the southern pine plantation forest estate in the south-east, the economic analysis outlined below considers the effects of an introduction of *F. circinatum* into a maturing plantation crop of radiata pine. The

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scenario outlined excludes the additive effect of the severe 5-year drought which is believed to have contributed to the high number of tree deaths (*P. radiata*) that occurred in California in the years following the arrival of the disease in that State in 1986.

Assumptions

Assumptions made are:

- The disease occurs in a newly planted stand and spreads from a single point source.
- The fungus will become established and wide-spread.
- The rate of spread will be 100 km/year.
- Once established, there will be 2% increase in mortality, 25% reduction in growth rate and 50% increase in stem deformation.
- Stands will be managed and harvested normally.
- Current log prices will be maintained in real terms regardless of the presence or absence of the disease.

Note that these effects are based on assumptions rather than actual data. Although the assumed rate of disease spread is to a degree based on the Californian experience, and increase in mortality on the results for southern pines, the assumed reduction in stand growth rate and increase in deformation are significantly higher than those recorded in the southern pine studies. Radiata pine is considered to be extremely susceptible to the disease. The decision to use higher rates of growth loss and deformation occurrence in the analysis reflects the fact that the New Zealand radiata pine plantation estate has not previously had to face whatever selective pressure pine pitch canker may cause. This suggests the possibility that impacts in a plantation radiata pine estate may be greater than those occurring in an estate and environment where interaction between species and disease has been endemic for over half a century. Estimates of pre-disease and post-disease financial returns can be compared and used to assess possible economic impacts.

Pre-disease returns

In New Zealand radiata pine plantation forestry is reported as having an Internal Rate of Return (IRR) of 8.5% (NZIER 2001). In terms of present values this sort of IRR would give a net present value (NPV) of \$1,850/ha (6% discount rate) or a loss of \$892/ha (10% discount rate). At 8% the NPV is of the order of \$480. This result is in line with what might be projected as, although returns of upwards of 15% have at times been promised, actual returns so far achieved on

investments have more typically been of the order of 6- 8% per annum (Horgan 1996).

Post-disease returns

Pitch canker can affect both harvested volume and the distribution of log grades. A net reduction of 25% in the expected harvest volume (pre-disease) with log values and grade distribution assumed to remain unchanged could be expected to reduce the IRR by 1.3%. At a 6% discount rate such a reduction in harvest volume effectively reduces the expected income (NPV terms) by \$600/ha. Applying a slightly different grade distribution to the projected post-disease harvest volume to reflect slower growth could magnify the loss and reduce the NPV to \$400/ha – a further \$850/ha reduction in the NPV. This would also significantly reduce the IRR by approximately a further 0.9%. Lack of information on how much damage is likely effectively precludes investigation of the effect of increased stem/log deformation on log values.

Analysis applying the assumptions outlined suggests that volume losses associated with infection of the whole stand over the entire rotation would (at a 6% discount rate) have a present value of NZ \$600-1450/ha. At an 8% discount rate the impact would be of the order of \$850/ha and at a 10% discount rate it would be \$400 to \$465/ha. With IRRs for radiata pine currently ranging between say 6 and 8.5 to 9%, should investor's discount rates exceed 8% growing radiata pine would not appear to be a desirable activity. Other types of investment yielding higher returns would seem to be more suited to their needs, particularly if the view regarding future prices is in line with that of the Food and Agriculture Organization of the United Nations (FAO 1999). Pitch canker can be expected to reduce returns below current levels and make the growing of radiata pine less attractive than at present.

Assuming that typical IRRs for New Zealand radiata pine are of the order of 8.5% and that there is a 1.3 to 2.2% reduction in IRR due to the disease, there is a real possibility that investors using discount rates greater than 6% would switch from radiata pine to other crops. This reduction in IRR possibly represents an extreme case. It is unlikely that all stands or all trees in a stand would become infected. Based on experience in south-eastern USA with southern pines, volume losses less than 20% of those assumed above might be anticipated (the loss in infected areas of a stand may be significantly higher but typically only a small percentage of total stand area is actually affected), reducing costs to about 20% of those estimated above.

The average age of the existing radiata pine estate is 14 years (NEFD 2002). The cost of a disease outbreak in a stand of this age would be lower than for the extreme case outlined above which assumed infection in the very early years of the crop's life, and somewhat more than the cost of infection in the last year of a crop rotation. In fact the cost of an outbreak at this age, based on the cost of the two extremes, is likely to be NZ \$170-1,000/infected hectare. This is the range that would apply once the disease becomes widespread.

At present New Zealand is free of pitch canker. If a one-time single point introduction is followed by spread at the rate of 100 km/yr, the disease could, depending on precisely where the introduction occurred take anywhere between 10 and 20 years to spread to all the radiata pine growing areas of New Zealand.

In view of these considerations, the actual economic cost of the disease might be reduced to 10% of that estimated for the extreme case scenario, giving a net cost of NZ \$17-100/ha over the whole radiata pine estate. This value is similar to that calculated for losses from *Dothistroma pini* (New 1989). It is unlikely to influence the management of existing radiata pine stands. However, if the disease were to become established, it is likely that some potential pine forestry investors would switch to other investments.

Another point to consider is that if the infection of pruned stubs occurs the value of the pruned component of much of the estate could be compromised. Although only 24% of the harvest is pruned 16% of the volume is pruned logs and this represents 40% of current value (NZFOA 2003). This would ensure an overall loss many times greater than that described in this analysis where it is assumed that the major loss is due to a mortality increase of 2%.

Any increased mortality is a concern, but stem deformation and reduced growth rate, if significant, are likely to be of greater economic importance. The costs of the disease would probably be able to be reduced in the longer-term due to incorporation of genetic resistance into breeding strategies. Stand and silvicultural management practices can also be changed to reduce the incidence and course of the disease.

Effect on export trade

A full assessment of the impact of discovery of pitch canker on New Zealand's export trade would involve analysis of the effect on a number of products in approximately 40 different markets. Logs and green sawn timber constitute the greatest risk in terms of introduction of pitch canker to new areas. However, any restrictions

imposed by Australia, Japan and the USA would be likely to have a small economic cost and would probably result in speeding up of cultural changes within the New Zealand forest industry. Some of these changes are already occurring for other reasons, e.g. there is already a trend towards the production and export of kiln-dried timber. Restrictions could add support to calls for export of processed wood rather than logs. It is unlikely that an outbreak of pitch canker in New Zealand would stop exports of kiln-dried timber to these three markets.

Cost of eradication

The greatest economic impacts of the appearance of a fungal disease in a new area may be due not to the organism itself but to the measures taken in an attempt to eradicate it. Most eradication programmes involve isolation of infected/diseased material and the establishment of a quarantine area around infected individuals. Within the isolation zone destruction or controlled disposal of infected and other material is attempted. The economic impacts of these measures can be far greater than those produced by the effects of the disease on the trees.

Conclusions

Will pitch canker be the terminator of economic viability...? Well, like all really interesting questions the safe answer should be along the line of "It all depends...". However, the real world answer would appear to be "not in most cases".

References

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